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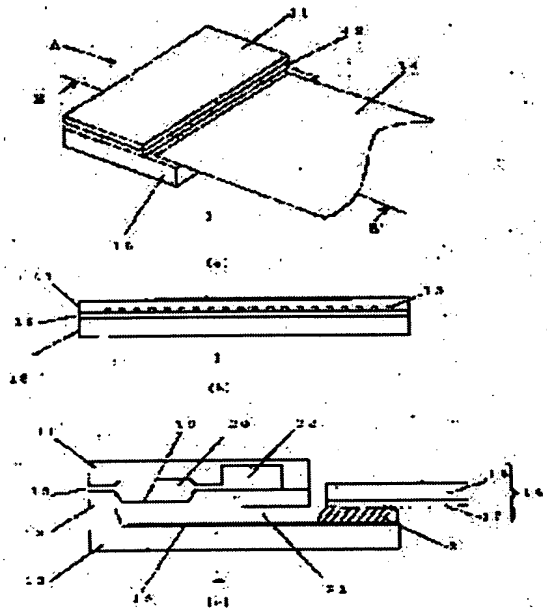
(54) METHOD FOR MANUFACTURING RECORDING HEAD OF INK JET RECORDER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a method for manufacturing the recording head of an ink jet recorder realizing high density nozzle arrangement in which reliability can be enhanced in the connecting method of individual electrodes and a printed board while reducing the cost.

SOLUTION: A wiring pattern on a printed board for connecting individual electrodes with a voltage applying means is connected electrically with the individual electrodes by means of a conductive material through an insulation interval with respect to the end part of a diaphragm substrate.



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CLAIMS

[Claim(s)]
[Claim 1] A liquid room unit which carries out the regurgitation of the ink drop from a nozzle with a variation rate of a diaphragm An actuator unit to which voltage is impressed between an individual electrode and a common electrode, and the variation rate of the diaphragm is carried out with a voltage impression means It is the recording head manufacture method of an ink jet recording device equipped with the above, and a circuit pattern on a printer substrate for connecting a voltage impression means with an individual electrode is characterized by placing insulation distance between actuator units and connecting with an individual electrode electrically with a conductive material.
[Claim 2] It is the recording head manufacture method of the ink-jet recording device which is equipped with the following and is characterized by for the circuit pattern on a printer substrate for connecting a voltage impression means with an individual electrode to place insulation distance between edges of a diaphragm substrate , and to be electrically connected it with an individual electrode with a conductive material by the voltage impression means in the recording head manufacture method of the ink-jet recording device which impresses voltage between an individual electrode and a diaphragm , is made to carry out the variation rate of the diaphragm , and carries out the regurgitation An electrode substrate with which two or more individual electrodes were formed A diaphragm substrate which functions as a common electrode while two or more diaphragms connected corresponding to an electrode according to each are formed A liquid room substrate which forms ink passage which is open for free passage for a nozzle while countering this diaphragm substrate and being prepared A voltage impression means to which voltage is impressed between an individual electrode and a diaphragm and the variation rate of the diaphragm is carried out
[Claim 3] Said insulation distance is the recording head manufacture method of an ink jet recording device according to claim 1 or 2 which is more than the thickness of said conductive material.
[Claim 4] A manufacture method of a recording head of an ink jet recording device according to claim 3 that thickness of said conductive material is 100 micrometers or less.
[Claim 5] A recording head manufacture method of an ink jet recording device according to claim 1 or 2 which forms said insulation distance by insulating material.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] Especially this invention relates to the manufacture method of the recording head of an electrostatic type ink jet recording device of making ink breathing out, by making the wall of a liquid room transform according to electrostatic force about the recording head manufacture method of an ink jet recording device.
[0002]
[Description of the Prior Art] The non impact record method is a point small to the degree which can disregard noise generating at the time of record, and attracts attention as an object for office etc. High-speed record is possible among them, various methods are proposed from the former, or it is a very leading method and it is used [the so-called ink jet record method which can be recorded without requiring fixation processing special to the so-called regular paper is already produced commercially, and]. Such an ink jet record method records by making the globule of the record liquid called the so-called ink fly, and making it adhere to the recorded body, and is divided roughly into some following methods by the control method for controlling the evolution method of the globule of a record liquid, and the flight direction of a globule.
[0003] The 1st method is indicated by for example, the U.S. Pat. No. 3060429 description. This is Tele. It is called a type method, the globule of a record liquid is generated in electrostatic attraction, and electric-field control of the generated globule is carried out according to a record signal, and on the recorded body, this globule is made to adhere selectively and it records. Apply electric field between a nozzle and an accelerating electrode, between xy deflecting electrodes constituted according to the record signal in the globule which was made to breathe out from a nozzle the globule of the record liquid charged uniformly, and breathed it out so that electric control might be possible is made to fly in details more, and a globule is made to adhere on the recorded body selectively by change of electric field on the strength.
[0004] The 2nd method is indicated by for example, the U.S. Pat. No. 3596275 description, the U.S. Pat. No. 3298030 description, etc. This calls it an electrification control system, is called a Sweet method, generates the globule of the record liquid which the amount of electrifications made control by the continuation oscillating evolution method, makes between the deflecting electrodes with which the globule by which this amount of electrifications was controlled is applied to uniform electric field fly, and makes it record on the recorded body. Predetermined carries out distance alienation of the electrification electrode with which the record signal was made to be impressed before the orifice (delivery) of the nozzle which is the part which specifically constitutes the recording head to which the piezo oscillating element is attached, it arranges, a piezo oscillating element is mechanically vibrated by impressing the electrical signal of constant frequency to a piezo oscillating element, and the globule of a record liquid is made to breathe out from an orifice. At this time, electrostatic induction of the charge is carried out to the globule which carries out the regurgitation with an electrification electrode, and a globule is charged in the amount of charges according to a record signal. The globule by which the

amount of electrifications was controlled will receive a deflection according to the amount of electrifications added when fixed electric field flew between the deflecting electrodes covered uniformly, and only the globule which bears a record signal will adhere on the recorded body.
[0005] The 3rd method is indicated by for example, the U.S. Pat. No. 3416153 description. This is a method which calls it a divergence control system, is called a Hertz method, applies electric field to the electrification inter-electrode of the shape of a nozzle and a ring, is made to carry out generating atomization of the globule of a record liquid with a continuation oscillating evolution method, and is recorded. That is, the atomization condition of a globule is controlled and the gradation nature of a record image is made to take out and record by modulating the field strength applied to a nozzle and electrification inter-electrode according to a record signal.
[0006] The 4th method is indicated by for example, the U.S. Pat. No. 3747120 description. This is the electrical and electric equipment and a machine conversion method, and is called a Stemme method, and, as for the 1-3rd above-mentioned methods, principles differ fundamentally. That is, to controlling electrically the globule of the record liquid breathed out from the nozzle while flying, and making it record by making the globule which bore the record signal adhere on the recorded body selectively, according to a record signal, each of 1-3rd methods carries out regurgitation flight, and records the globule of a record liquid from a delivery by this Stemme method. That is, a Stemme method impresses an electric record signal to the piezo oscillating element attached to the recording head which has the delivery which carries out the regurgitation of the record liquid, changes it into the mechanical oscillation of a piezo oscillating element, carries out regurgitation flight of the globule of a record liquid, and is made to adhere to the recorded body from a delivery according to this mechanical oscillation.
[0007] Although these four methods have the feature to each, they also have simultaneously the technical-problem point which should be solved. First, the direct energy for generating the globule of a record liquid is electric energy, and the 1st - the 3rd method also depend deflection control of a globule on electric-field control. Therefore, although the 1st method is simple constitutionally, generating of a globule takes high tension, and the formation of a multi-nozzle of a recording head is difficult, and unsuitable for high-speed record. Although the formation of a multi-nozzle of a recording head is possible for the 2nd method and it is fit for high-speed record, it is complicated constitutionally, and electric control of the globule of a record liquid is difficult for it at altitude, and a satellite dot tends to produce it on the recorded body. Although the record which was excellent in gradation nature by atomizing the globule of a record liquid is possible for the 3rd method, control of an another side atomization condition is difficult. Moreover, fogging arises in a record image, or the formation of a multi-nozzle of a recording head is difficult, and high-speed record has the defect of being unsuitable.
[0008] On the other hand, the 4th method has comparatively many advantages. First, a configuration is simple. Moreover, in order to record by making a record liquid breathe out from the delivery of a nozzle by on demand one, it is not necessary to collect the globules which image recording did not take among the globules which carry out regurgitation flight like the 1st - the 3rd method. Moreover, it is not necessary to use a conductive record liquid, and has the advantage that the flexibility on the matter of a record liquid is large, like the 1st and 2 method. however, the miniaturization of a piezo oscillating element which a problem is on processing of a recording head and has desired resonance frequency on the other hand is very difficult -- etc. -- the formation of a multi-nozzle of a reason to a recording head is difficult. Moreover, since mechanical energy called the mechanical oscillation of a piezo oscillating element is made to perform regurgitation flight of the globule of a record liquid, it is the difficulty of the above-mentioned formation of a multi-nozzle, and what is unsuitable for high-speed record conjointly.
[0009] Then, according to the ink jet recording method of the disclosure to JP,56-9429,B proposed conventionally, such inconvenience can also be canceled mostly. This heats the ink of the liquid interior of a room, generates air bubbles, makes ink produce a pressure buildup, makes ink jump out of a detailed capillary tube nozzle, and is made to record.
[0010] There are some which were indicated by JP,61-59914,B as same recording method. This forms the flight-drop of the liquid breathed out from a delivery, makes this drop adhere to the recorded body, and makes it record by heating some liquids in the liquid route which opens a liquid for free passage to

the delivery for making it breathe out in the predetermined direction, and making film boiling occur.
[0011] The more concrete manufacture method of the recording head of this method In ink as an energy source which gives the energy for drop generating to the predetermined location on a substrate as indicated by JP,62-59672,B A heater element, After installing two or more active elements, such as a piezoelectric device, fixed (an electrode is formed suitably), a photosensitive constituent layer is formed in a substrate front face by the applying method etc. by predetermined thickness. By the usual photolithography method The ink passage slot for forming ink passage, such as the orifice section, the operation section, ink supply ****, and the ink discharge passage section, is formed, and he joins a top cover after this, and is trying to manufacture a recording head. Thus, by using photolithography, densification becomes possible. However, by this record method, making a heating element generate heat to an elevated temperature in ink, and in order to expand and extinguish air bubbles momentarily further, that heat stress and the ink which a heating element tends to deteriorate and can be used with an impact have the defect that there is little flexibility.
[0012] This defect is solved and there is technology indicated by JP,3-293141,A as a method which moreover realized densification by the activity of photolithography. This impresses voltage to electrode Seki of a substrate and a diaphragm, is the record method of sagging a diaphragm and performing the ink regurgitation according to electrostatic force, and forms a liquid room and a diaphragm in a silicon substrate by etching as the head formation method. Moreover, the method of joining a head electrode which is indicated by JP,7-246706,A, and the printed circuit board by the different direction conductivity film as a mounting arrangement of this ink jet arm head and printed circuit board is indicated. Moreover, generally the method using a pewter as other connection methods is also learned. It is the method of connecting a different direction electric conduction film and a pewter through these between a printed circuit board and an electrode, and, generally, as for the processing method, thermocompression bonding is used.
[0013]
[Problem(s) to be Solved by the Invention] However, although the nonconformity that a different direction electric conduction film and a pewter contact a nozzle plate and a diaphragm after cementation, or the ink which turned from the nozzle side contacts a different direction conductivity film and a pewter, and a contiguity electrode leaks at the time of cleaning of a nozzle etc. may arise, about these, it is not indicated at all.
[0014] This invention is made in view of these troubles, and while being able to improve the reliability of the connection method of an individual electrode and a printed circuit board with the ink jet recording device which realized the nozzle configuration of high density, it aims at offering the recording head manufacture method of an ink jet recording device that low cost-ization can be attained.
[0015]
[Means for Solving the Problem] A liquid room unit which carries out the regurgitation of the ink drop from a nozzle with a variation rate of a diaphragm in order to solve said trouble, According to a recording head manufacture method of a recording device of an ink jet recording device concerning this invention of having an actuator unit to which voltage is impressed between an individual electrode and a common electrode, and the variation rate of the diaphragm is carried out with a voltage impression means A circuit pattern on a printer substrate for connecting a voltage impression means with an individual electrode places insulation distance between actuator units, and is electrically connected with an individual electrode with a conductive material. Moreover, an electrode substrate with which two or more individual electrodes were formed and a diaphragm substrate which functions as a common electrode while two or more diaphragms connected corresponding to an electrode according to each are formed, A liquid room substrate which forms ink passage which is open for free passage for a nozzle while countering this diaphragm substrate and being prepared, It has a voltage impression means to which voltage is impressed between an individual electrode and a diaphragm and the variation rate of the diaphragm is carried out. According to a recording head manufacture method of an ink jet recording device concerning this invention which impresses voltage between an individual electrode and a diaphragm, is made to carry out the variation rate of the diaphragm, and carries out the regurgitation of

the ink drop from a nozzle with a voltage impression means A circuit pattern on a printer substrate for connecting a voltage impression means with an individual electrode places insulation distance between edges of a diaphragm substrate, and is electrically connected with an individual electrode with a conductive material. Furthermore, insulation distance is more than the thickness of a conductive material, and thickness of the conductive material is 100 micrometers or less. Moreover, insulation distance is formed by insulating material. Therefore, even if conductive materials, such as a pewter and different **********, overflow a circuit pattern on a printed circuit board, a reliable electric power supply which did not contact an actuator unit, especially a diaphragm substrate and was stabilized is made. Moreover, it becomes possible as a liquid room substrate which constitutes an actuator unit to use comparatively cheap materials, such as SUS, and a price of the whole recording head can be lowered.
[0016]
[Embodiment of the Invention] The circuit pattern on the printed circuit board for connecting a voltage impression means with an individual electrode places insulation distance between the edges of a diaphragm substrate, and is electrically connected with an individual electrode with a conductive material.
[0017]
[Example] Drawing 1 is drawing showing the configuration of the recording head of the ink jet recording device concerning the 1st example of this invention. (c) of the side elevation where (a) of this drawing saw (b) of a perspective diagram and this drawing from [in (a) of this drawing] arrow head A, and this drawing is a B-B' cross section in (a) of this drawing. In this drawing, the recording head 1 of the ink jet recording device in this example FPC (Flexible Printed Circuit: flexible print circuit)14 which is the liquid room substrate 11, the diaphragm substrate 12, the electrode substrate 13, and a printed circuit board, a nozzle 15, the base 16 of FPC14, the electrode lead 17 of FPC14, the individual electrode 18, The individual electrode 18 of the electrode substrate 13 is electrically connected with a diaphragm 19, the liquid room 20, and the electrode lead 17 of FPC14, for example, it is constituted including the conductive materials 21, such as a pewter and a different direction conductivity film. Moreover, it is the liquid room which the common liquid room 22 is open for free passage in each liquid room, and supplies ink, and a gap 23 is a gap between the individual electrode 18 and a diaphragm 19. In addition, in order to carry out simple [of the explanation], the ink supply means to an ink liquid room etc. is omitted, and since it is easy, one (c) of drawing 1 is shown.
[0018] Moreover, since the diaphragm substrate 12 is desired thickness, can form a detailed pattern with a sufficient precision and can use diaphragm substrate 12 itself also as a common electrode by etching metals and Si, such as SUS, it is desirable. Furthermore, when insulating materials, such as glass, are used, a common electrode can be formed in a front face by forming metals, such as aluminum, Cu, Cr, nickel, and Au, by methods, such as vacuum evaporationo and a spatter.
[0019] And the electrode substrate 13 can form the individual electrode 18 only in a gap 23 by etching metals, such as SUS, glass, Si, etc. by forming the gap of desired height, forming membranes further in the thickness of a request [about the gap] of electrode materials, such as nickel, aluminum, Ti/Pt, and Cu, with membrane formation technology, such as a spatter, CVD, and vacuum evaporationo, and forming and etching a photoresist after that. the case where a metal is used as an electrode substrate 13 -- a it top -- resin and SiO2 etc. -- an insulating layer is formed with an insulating material and the individual electrode 18 is formed on it. the object which prevents that an electrode is further damaged by the short circuit and discharge on the individual electrode 18 -- SiO2 etc. -- the insulating layer to depend may be formed.
[0020] Moreover, a slot is formed in the liquid room substrate 11 by the method of common knowledge, such as machining of dicing etc., and electroforming, such as etching, passage is formed by joining the liquid room substrate 11 and the diaphragm substrate 12, and a nozzle 15 can form the end face as a nozzle. As a material of the liquid room substrate 11, insulating materials, such as semiconductors, such as metals, such as SUS, and Si, and glass, etc. are used. When a conductive material, for example, a metal, and Si are used, in order to drop internal ink to a grand level, it is desirable to connect the liquid room substrate 11 to a gland. In order to secure water repellence with ink, a water-repellent finish is

performed in the regurgitation front face of a nozzle side by the well-known method, for example, plating, or water repellent coating. In addition, the liquid room substrate 11, the diaphragm substrate 12, and the electrode substrate 13 are joined by the direct cementation methods, such as adhesives and anode plate cementation, etc.

[0021] The printed circuit board of the shape of a film which consists of a tabular printed circuit board which consists of a glass epoxy resin, phenol resin, etc., polyimide resin, PET, etc. as FPC14 on the other hand is used. On the base 16 of FPC14, the electrode lead 17 for impressing voltage to the individual electrode 18 is formed.

[0022] Furthermore, as a method of connecting the electrode pad of the individual electrode 18 with the electrode lead 17 on FPC14 electrically, there are the method of carrying out thermocompression bonding of the pewter, a method of carrying out thermocompression bonding with different direction electroconductive glue, and the method of carrying out the pressure welding of inter-electrode, for example. Since these can connect inter-electrode [two or more] at once, they are the methods excellent in the point that processing is easy and low cost. Furthermore, also in this, in order for substrates to paste up after sticking by pressure, the thermocompression bonding of a pewter or a different direction conductivity film has neither subsequent processing, an assembly nor a fear of the ability of inlet connection to take in printing actuation etc., and is the connection method which was excellent especially in respect of reliability. in connecting with FPC14, the electrode substrate 13 is attributed size from the diaphragm substrate 12 for electrode ejection, and it is necessary to consider as the configuration which took out the electrode pad section to the front face with the configuration which formed the diaphragm substrate 12 on the electrode substrate 13 In this condition, if FPC14 is connected by the pewter or the different direction conductivity film, as the reference mark C in drawing 2 shows, the pewter minded in between at the edge of FPC14 and a different direction conductivity film will overflow with the pressure at the time of thermocompression bonding. In the recording head 1 of the ink jet equipment of this example, the diaphragm substrate 12 serves as a common electrode. When Si is used, diaphragm substrate 12 itself will become a common electrode, and the diaphragm substrate 12 will expose the FPC14 side. Moreover, also when a common electrode is formed in front faces, such as glass, with a metallic material, it will be good to form a common electrode all over the diaphragm substrate 12, and a common electrode will be exposed from the ease of processing, in an edge even in such a case. Therefore, the nonconformity that a common electrode will connect with the electrode of FPC14 and the individual electrode 18 too hastily arises.

[0023] So, in this example, the crevice for securing insulation distance shall be prepared between the edge of the electrode lead 17 of FPC14, and the diaphragm substrate 12, and the crevice shall be set as the clearance which does not contact the diaphragm substrate 12 even if a different direction conductivity film and a pewter overflow. Here, the example using a different direction conductivity film is shown. The conductive material 11 which is different ********** (or different direction electric conduction film) distributed the conductive particle called a filler into thermoplastic or thermosetting resin, and it is inserting between electrodes, and heating and pressurizing, and the conductive material 11 which is different ********** is crushed, and a filler contacts two electrodes, and it can take an inter-electrode flow. Furthermore, the outcrop of the liquid room substrate 11 or the diaphragm substrate 12 is covered with the insulating material. As this insulating material, it is the point which can be easily insulated in comparison, and liquefied resin is used preferably. In addition, it is SiO2 by heating at an elevated temperature, when the liquid room substrate 11 and the diaphragm substrate 12 are created by Si. A layer may be formed in a front face. Thereby, even if the flash of solder or an anisotropy electric conduction film arises, an electrode pattern, and the liquid room substrate 11 or the diaphragm substrate 12 of FPC14 do not contact, and generating of leak does not arise.

[0024] Moreover, after performing alignment to the polar zone of printed circuit boards, such as FPC14, so that it may be located in the end face of FPC14 as shown in (a) of drawing 3 , temporary sticking by pressure is carried out and the conductive material 11 which are FPC14 and a different direction conductivity film is stuck. Therefore, since alignment is performed for the conductive material 11 which is a different direction conductivity film by the end face of FPC14, without needing the special pattern

and special member for deciding the crimped position of the conductive material 11 which is a different direction conductivity film, and a configuration, it is hard to produce variation in the location of the conductive material 11 which is a different direction conductivity film, therefore there is no dispersion in the connection area of FPC14 and the individual electrode 18. Therefore, since the variation in contact resistance decreases, there is little variation in the voltage (driver voltage of a diaphragm) built between a diaphragm 19 and the individual electrode 18 between arm heads, and the discharging performance stabilized in every arm head is obtained. Moreover, since it is not bent and stuck in the electrode array direction of FPC14 by pressure, also within an arm head, almost equal driver voltage is built with all nozzles, and the variation between nozzles also decreases. Then, as shown in (b) of drawing 3 , the protection film of the conductive material 11 which is a different direction conductivity film is removed, and alignment is performed for the electrode pad section of the electrode substrate 13, and the electrode lead 17 of FPC14. Then, as shown in (c) of drawing 3 , the heated sticking-by-pressure arm head 24 is pressed against an electrode field, and carries out thermocompression bonding. Although the conductive material 11 which is a different direction conductivity film is crushed at this time and it spreads in the direction of an edge of FPC14, since the amount which spreads beforehand is foreseen, and the head of FPC14 is released with the diaphragm substrate 12 and is carrying out alignment, even if it overflows the edge of FPC14 after sticking by pressure, the diaphragm substrate 12 is not contacted.

[0025] Furthermore, in a sticking-by-pressure experiment, although the gap of the crevice between the head of FPC14 and the head of the diaphragm substrate 12 was based also on the thickness of the conductive material 11 which is a different direction conductivity film, when it was more than thickness, even if it was preferably heated and stuck by pressure from the edge of FPC14, it did not contact the diaphragm substrate 12. Furthermore, if the thickness of the conductive material 11 which is a different direction conductivity film is too thick, the nonconformity that the gap of the head of FPC14 and the diaphragm substrate 12 becomes large too much, therefore the electrode substrate 13 becomes large, and the cost of the electrode substrate 13 becomes high will arise. However, it is not necessary to enlarge thickness of the electrode substrate 13 so much, and most rises of cost are lost by setting to 100 micrometers or less thickness of the conductive material 11 which is a different direction conductivity film.

[0026] In addition, this example has the same problem also with the arm head of a side shooter mold, although the injection direction of ink described the case where they were a diaphragm side and the so-called side shooter type of perpendicular ink jet, and this example is effective.

[0027] Suppose that the example by this example is shown below. The recording head 1 was created with the configuration of drawing 1 . The width of face of the liquid room 20 of ink set 0.13mm, the depth of 2.0mm, and a pitch to 0.169mm (300dpi). The diaphragm substrate 12 of 0.5mm of board thickness which formed the diaphragm 19 with a thickness of 5 micrometers by etching of Si, To the pars basilaris ossis occipitalis of a 0.5-micrometer slot (it becomes a gap), it is the individual electrode (width of face of 0.14mm) of TiN. Pitch 0.169mm is formed and it is 100nm SiO2 on it further. The electrode substrate 13 in which the insulating layer was formed was joined with adhesives, further, on the diaphragm substrate 12, the liquid room substrate 11 of 0.5 micrometers of board thickness was connected, and the recording head 1 was formed. The height of a nozzle 15 was set to 20 micrometers at this time. The number of nozzles is 192 channels. As mentioned above, alignment is made an edge and temporary sticking by pressure of the different direction conductivity film (Three Bond 3370C, 35 micrometers of thickness) is carried out at FPC14. Temporary sticking by pressure performed 150 degrees C and a sticking-by-pressure pressure by 2.94x106 Pa, and performed sticking-by-pressure time amount for the temperature of the sticking-by-pressure arm head of a sticking-by-pressure machine in 1 second. Furthermore, the electrode lead 17 of this FPC14 was opened in the electrode pad of an arm head the gap (0 or 10 micrometers, 20 micrometers, 35 micrometers, 50 micrometers, 100 micrometers), and where alignment is carried out, actual sticking by pressure was carried out. This sticking by pressure performed temperature of a sticking-by-pressure arm head at 150 degrees C, and performed 2.94x106 Pa and sticking-by-pressure time amount for welding pressure in 20 seconds. The individual electrode 18 and the electrode of FPC14 paste up, and it enabled it to supply driver voltage to the individual electrode

18 through FPC14 and a different direction conductivity film with a different direction conductivity film by this. Moreover, it lets the ink feed hopper which was open for free passage in the liquid room 20 of the ink of this recording head 1 pass, and enabled it to supply ink from an ink tank.
[0028] The recording head unit of this ink flight is constituted considering the manifold formed by having the ink supply room of the hollow connected to the ink supply pipe (ink supply means) as base material. The ink which the recording head chip was fixed and was supplied from the ink supply pipe passes along an ink supply room, is led to the crowning of a manifold, is supplied to the common passage of a recording head chip from the ink feed hopper prepared in the edge of a recording head chip, and is carried to the crowning of a manifold by the capillarity of each ink supply channel to each energy operation section after that. Furthermore, presser-foot immobilization of the recording head chip is carried out by the attachment component of the shape of a bonnet and a frame in the perimeter.
[0029] Next, actuation of the example by this example is explained. first, the ink supplied to the ink feed hopper from the ink supply pipe -- common passage -- ** -- it is filled throughout the ink supply channel later on. If it energizes according to an individual to the electrode according to each according to image information, electrostatic force will occur between the individual electrode 18 and a diaphragm 19, and a diaphragm 19 will displace to the individual electrode 18 side. Next, if energization is turned off, a diaphragm 19 tends to return to the original condition. By rapid capacity change at this time, ink serves as a drop from a nozzle and flies.
[0030] When the diaphragm substrate 12 of this arm head was made into the gland, the following pulse voltage was impressed to the individual electrode 18, that actuation wave was observed with the oscilloscope, and gaps were 0 or 10 micrometers and 20 micrometers, it became a gland and the leaked wave (wave of a grand level), but when film pressure was 35 micrometers or more, generating of leak with a gland and leak with a contiguity electrode was not seen..
[0031]
Driver voltage :40V pulse width : 15microsec continuation drive frequency : 10kHz [0032] Drawing 4 is drawing explaining the trouble in the 2nd example of this invention. In this drawing, the same reference mark as drawing 2 shows the same component. According to this example, if FPC14 is connected by the pewter or the different direction conductivity film, the pewter minded between the electrode leads 17 of FPC14 and a different direction conductivity film will overflow with the pressure at the time of thermocompression bonding. Since the liquid room substrate 11 is exposing and carrying out the FPC14 side then, not only the diaphragm substrate 12 but the liquid room substrate 11 may be contacted. Since the liquid room substrate 11 is connected to a gland as mentioned above when the liquid room substrate 11 is created with a conductive material, and also when a common electrode is formed in front faces, such as glass, with a metallic material, from the ease of processing, it will be good to form a common electrode all over the diaphragm substrate 12, and a common electrode will be exposed in an edge even in such a case. Therefore, the nonconformity that the liquid room substrate 11 of a grand level will connect with the electrode of FPC14 and the individual electrode 18 too hastily arises.
[0033] In this example, the crevice for securing insulation distance shall be prepared between the liquid room substrate 11 and the edge of the electrode lead 17 of FPC14, and the crevice shall be set as the clearance which does not contact the liquid room substrate 11 even if a different direction conductivity film and a pewter overflow. The example using a different direction conductivity film is shown. The different direction conductivity film (or different direction electric conduction film) distributed the conductive particle called a filler into thermoplastic or thermosetting resin, and it is inserting between electrodes, and heating and pressurizing, and a different direction conductivity film is crushed, and a filler contacts two electrodes, and it can take an inter-electrode flow. As shown in (a) of drawing 3 , after performing alignment to the polar zone of printed circuit boards, such as FPC14, so that it may be located in the end face of FPC14, temporary sticking by pressure is carried out and FPC14 and a different direction conductivity film are stuck to it. Therefore, since alignment is performed for a different direction conductivity film by the end face of FPC14, without needing the special pattern and special member for deciding the crimped position of a different direction conductivity film, and a configuration, it is hard to produce variation in the location of a different direction conductivity film,

therefore there is no dispersion in the connection area of FPC14 and the individual electrode 18. Therefore, since the variation in contact resistance decreases, there is little variation in the voltage (driver voltage of a diaphragm) built between a diaphragm 19 and the individual electrode 18 between arm heads, and the discharging performance stabilized in every arm head is obtained. Moreover, since it is not bent and stuck in the electrode array direction of FPC14 by pressure, also within an arm head, almost equal driver voltage is built with all nozzles, and the variation between nozzles also decreases. Then, as shown in (b) of drawing 3 , the protection film of a different direction conductivity film is removed, and alignment is performed for the electrode pad section of the electrode substrate 13, and the electrode lead 17 of FPC14. Then, as shown in (c) of drawing 3 , the heated sticking-by-pressure arm head 24 is pressed against an electrode field, and carries out thermocompression bonding. Although a different direction conductivity film is crushed and it spreads in the direction of an edge of FPC14 at this time, since the amount which spreads beforehand is foreseen, and the head of FPC14 is released with the end face of the liquid room substrate 11 and is carrying out alignment, even if it overflows the edge of FPC14 after sticking by pressure, the liquid room substrate 11 is not contacted. Moreover, in a sticking-by-pressure experiment, although the gap of the crevice between the head of FPC14 and the head of the liquid room substrate 11 was based also on the thickness of a different direction conductivity film, when it was more than thickness, even if it was preferably heated and stuck by pressure from the edge of FPC14, it did not contact a diaphragm 19. If it has another way of speaking, since the thickness of a different direction conductivity film is about 25-50 micrometers, generally it is good to prepare [25 micrometers or more] 50 micrometers or more preferably.

[0034] Drawing 5 is drawing showing an example of the pattern of the electrode lead on FPC in the ink jet recording device concerning this invention. Solder plating of the pattern side is carried out, as shown in this drawing, it is pressed with the sticking-by-pressure arm head heated where an individual electrode's is contacted, and solder fuses, it is removing a sticking-by-pressure arm head, the fused solder solidifies, and an individual electrode is connected with the pattern of the electrode lead on FPC. Since the pattern of the electrode lead on FPC was formed inside the base end face of FPC and has prepared insulation distance relatively at this time, even if solder is pressed and it overflows into the end-face side of FPC, the end face of a printed circuit board is not overflowed previously, and, therefore, neither a diaphragm substrate nor a liquid room substrate is contacted.

[0035] In addition, this invention is not limited to the above-mentioned example, and if it is the publication in a patent claim, neither deformation of a variety nor a replaceable thing can be overemphasized.

[0036]

[Effect of the Invention] The liquid room unit which carries out the regurgitation of the ink drop from a nozzle with the variation rate of a diaphragm as explained above, According to the recording head manufacture method of the recording device of the ink jet recording device concerning this invention of having the actuator unit to which voltage is impressed between an individual electrode and a common electrode, and the variation rate of the diaphragm is carried out with a voltage impression means The circuit pattern on the printer substrate for connecting a voltage impression means with an individual electrode places insulation distance between actuator units, and is electrically connected with an individual electrode with a conductive material. Moreover, the electrode substrate with which two or more individual electrodes were formed and the diaphragm substrate which functions as a common electrode while two or more diaphragms connected corresponding to the electrode according to each are formed, The liquid room substrate which forms the ink passage which is open for free passage for a nozzle while countering this diaphragm substrate and being prepared, It has the voltage impression means to which voltage is impressed between an individual electrode and a diaphragm and the variation rate of the diaphragm is carried out. According to the recording head manufacture method of the ink jet recording device concerning this invention which impresses voltage between an individual electrode and a diaphragm, is made to carry out the variation rate of the diaphragm, and carries out the regurgitation of the ink drop from a nozzle with a voltage impression means The circuit pattern on the printer substrate for connecting a voltage impression means with an individual electrode places insulation distance

between the edges of a diaphragm substrate, and is electrically connected with an individual electrode with a conductive material. Furthermore, insulation distance is more than the thickness of a conductive material, and the thickness of the conductive material is 100 micrometers or less. Moreover, insulation distance is formed by the insulating material. Therefore, even if conductive materials, such as a pewter and different **********, overflow the circuit pattern on a printed circuit board, the reliable electric power supply which did not contact an actuator unit, especially a diaphragm substrate and was stabilized is made. Moreover, it becomes possible as a liquid room substrate which constitutes an actuator unit to use comparatively cheap materials, such as SUS, and the price of the whole recording head can be lowered.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the configuration of the recording head of the ink jet recording device concerning the 1st example of this invention.
[Drawing 2] It is drawing explaining the trouble in the 1st example.
[Drawing 3] It is drawing showing the situation of sticking by pressure of the printed circuit board in the 1st example, and a conductive material.
[Drawing 4] It is drawing explaining the trouble in the 2nd example of this invention.
[Drawing 5] It is drawing showing an example of the pattern of the contact section of the printed circuit board and individual electrode in the ink jet recording device concerning this invention.
[Description of Notations]
1: A recording head, 11:liquid room substrate, 12:diaphragm substrate, 13:electrode substrate, 14:printed circuit board, 15:nozzle, 16:base, 17:electrode lead, a 18:individual electrode, 19:diaphragm, 20:liquid room, 21:conductivity material, a 22:common liquid room, 23:gap, 24 : sticking-by-pressure arm head.

[Translation done.]

* NOTICES *

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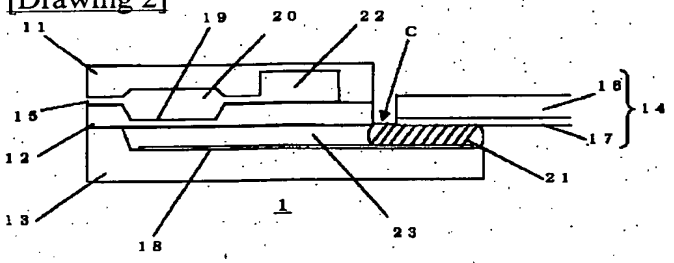
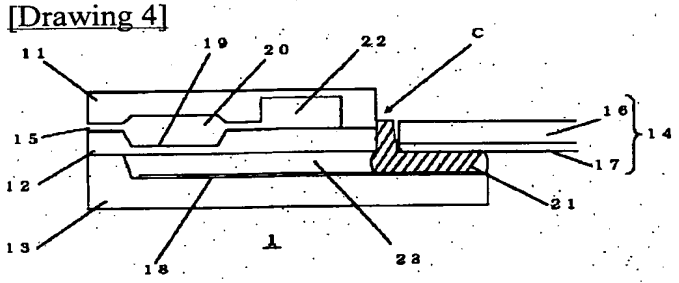
DRAWINGS

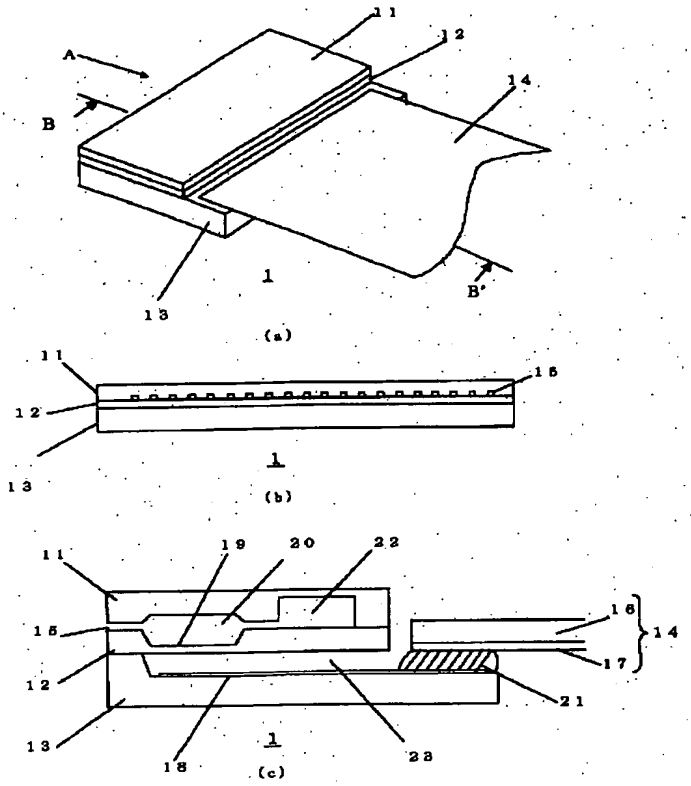
[Drawing 2]



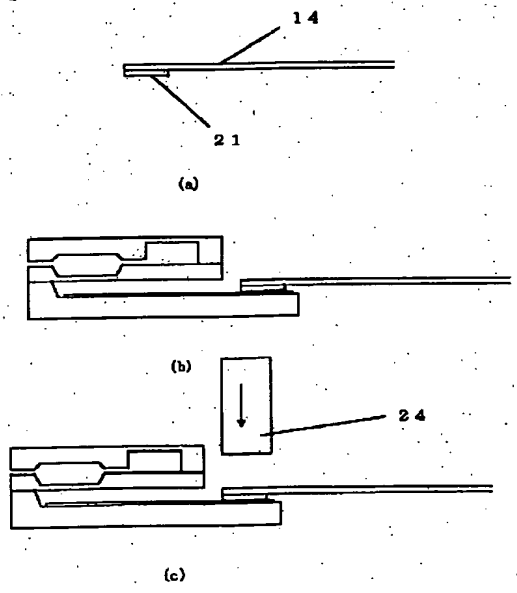
[Drawing 4]



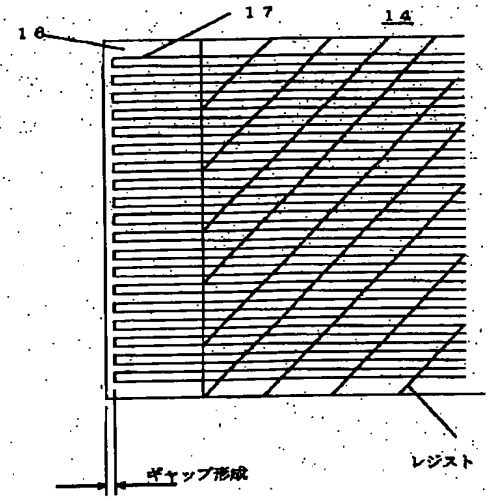
[Drawing 1]



[Drawing 3]



[Drawing 5]



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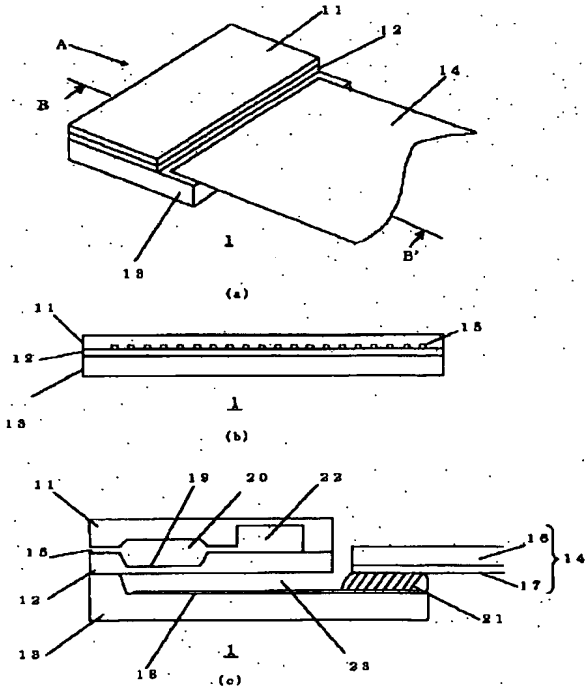
AG89 AP11 AP25 AP77 BA03
BA15

(54)【発明の名称】　インクジェット記録装置の記録ヘッド製造方法

(57)【要約】
【課題】　本発明は高密度のノズル配列を実現したインクジェット記録装置で個別電極とプリント基板の接続方法の信頼性を向上できると共に低コスト化を図ることができるインクジェット記録装置の記録ヘッド製造方法を提供することを目的とする。
【解決手段】　個別電極と電圧印加手段を接続するためのプリント基板上の配線パターンは、振動板基板の端部の間に絶縁間隔を置いて個別電極と導電性材料で電気的に接続される。



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【特許請求の範囲】

【請求項１】　振動板の変位によりノズルからインク液滴を吐出する液室ユニットと、電圧印加手段によって個別電極と共通電極の間に電圧を印加して振動板を変位させるアクチュエータユニットとを有するインクジェット記録装置の記録ヘッド製造方法において、

個別電極と電圧印加手段を接続するためのプリンタ基板上の配線パターンは、アクチュエータユニットの間に絶縁間隔を置いて個別電極と導電性材料で電気的に接続されることを特徴とするインクジェット記録装置の記録ヘッド製造方法。

【請求項２】　複数の個別電極が形成された電極基板と、各個別電極に対応して接続される複数の振動板が形成されると共に共通電極として機能する振動板基板と、該振動板基板に対向して設けられると共にノズルに連通するインク流路を形成する液室基板と、個別電極と振動板の間に電圧を印加して振動板を変位させる電圧印加手段とを有し、電圧印加手段によって個別電極と振動板間に電圧を印加して振動板を変位させてノズルからインク液滴を吐出するインクジェット記録装置の記録ヘッド製造方法において、

個別電極と電圧印加手段を接続するためのプリンタ基板上の配線パターンは、振動板基板の端部の間に絶縁間隔を置いて個別電極と導電性材料で電気的に接続されることを特徴とするインクジェット記録装置の記録ヘッド製造方法。

【請求項３】　前記絶縁間隔は前記導電性材料の膜厚以上である請求項１又は２に記載のインクジェット記録装置の記録ヘッド製造方法。

【請求項４】　前記導電性材料の膜厚が１００μｍ以下である請求項3記載のインクジェット記録装置の記録ヘッドの製造方法。

【請求項５】　前記絶縁間隔を絶縁材料により形成する請求項１又は２に記載のインクジェット記録装置の記録ヘッド製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明はインクジェット記録装置の記録ヘッド製造方法に関し、特に静電力により液室の壁を変形させることによりインクを吐出させる静電型インクジェット記録装置の記録ヘッドの製造方法に関する。

【０００２】

【従来の技術】ノンインパクト記録方法は、記録時の騒音発生が無視できる程度に小さい点で、オフィス用等として注目されている。その内、高速記録可能で、いわゆる普通紙に特別の定着処理を要せずに記録できる、いわゆるインクジェット記録方法は極めて有力な方法であり、従来から種々の方式が提案され、又は既に製品化されて実用されている。このようなインクジェット記録方法は、いわゆるインクと称される記録液体の小滴を飛翔させて被記録体に付着させて記録を行うものであり、記録液体の小滴の発生法及び小滴の飛翔方向を制御するための制御方法によって以下のような幾つかの方式に大別される。

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【０００３】第１の方式は、例えば米国特許第３０６０４２９号明細書に開示されているものである。これは、Ｔｅｌｅ　ｔｙｐｅ方式と称され、記録液体の小滴の発生を静電吸引的に行い、発生した小滴を記録信号に応じて電界制御し、被記録体上にこの小滴を選択的に付着させて記録を行うものである。より詳細には、ノズルと加速電極間に電界をかけて、一様に帯電した記録液体の小滴をノズルより吐出させ、吐出した小滴を記録信号に応じて電気制御可能なように構成されたｘｙ偏向電極間を飛翔させ、電界の強度変化によって選択的に小滴を被記録体上に付着させるものである。

【０００４】第２の方式は、例えば米国特許第３５９６２７５号明細書、米国特許第３２９８０３０号明細書等に開示されているものである。これは、荷電制御方式というものであって、Ｓｗｅｅｔ方式と称され、連続振動発生法により帯電量の制御させた記録液体の小滴を発生させ、この帯電量の制御された小滴を、一様電界がかけられている偏向電極間を飛翔させて、被記録体上に記録を行わせるものである。具体的には、ピエゾ振動素子の付設されている記録ヘッドを構成する一部であるノズルのオリフィス（吐出口）の前に記録信号が印加されるようにした帯電電極を所定の距離離間させて配置し、ピエゾ振動素子に一定周波数の電気信号を印加することでピエゾ振動素子を機械的に振動させ、オリフィスより記録液体の小滴を吐出させる。この時、吐出する小滴には帯電電極により電荷が静電誘導され、小滴は記録信号に応じた電荷量で帯電される。帯電量の制御された小滴は、一定電界が一様にかけられている偏向電極間を飛翔する時に、付加された帯電量に応じて偏向を受け、記録信号を担う小滴のみが被記録体上に付着することになる。

【０００５】第３の方式は、例えば米国特許第３４１６１５３号明細書に開示されているものである。これは、発散制御方式というものであって、Ｈｅｒｔｚ方式と称され、ノズルとリング状の帯電電極間に電界をかけ、連続振動発生法によって、記録液体の小滴を発生霧化させて記録される方式である。即ち、ノズルと帯電電極間にかける電界強度を記録信号に応じて変調することにより小滴の霧化状態を制御し、記録画像の階調性を出して記録させるものである。

【０００６】第４の方式は、例えば米国特許第３７４７１２０号明細書に開示されているものである。これは、電気・機械変換方式であって、Ｓｔｅｍｍｅ方式と称され、上記の第１～３の方式とは根本的に原理が異なるものである。即ち、第１～３の方式が、何れもノズルより吐出された記録液体の小滴を、飛翔している途中で電気

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的に制御し、記録信号を担った小滴を選択的に被記録体上に付着させて記録を行わせるのに対し、このＳｔｅｍｍｅ方式では、記録信号に応じて吐出口より記録液体の小滴を吐出飛翔させて記録するものである。つまり、Ｓｔｅｍｍｅ方式は、記録液体を吐出する吐出口を有する記録ヘッドに付設されているピエゾ振動素子に、電気的な記録信号を印加してピエゾ振動素子の機械的振動に変え、この機械的振動に従い吐出口より記録液体の小滴を吐出飛翔させて被記録体に付着させるものである。

【０００７】これらの４方式は、各々に特徴を有するが、同時に、解決すべき課題点もある。まず、第１～第３の方式は、記録液体の小滴を発生させるための直接的エネルギーが電気的エネルギーであり、かつ小滴の偏向制御も電界制御による。よって、第１の方式は、構成上はシンプルであるが、小滴の発生に高電圧を要し、かつ記録ヘッドのマルチノズル化が困難で高速記録には不向きである。第２の方式は、記録ヘッドのマルチノズル化が可能で高速記録に向くが、構成上複雑であり、かつ記録液体の小滴の電気的制御が高度で困難であり、被記録体上にサテライトドットが生じやすい。第３の方式は、記録液体の小滴を霧化することにより階調性に優れた記録が可能ではあるが、他方霧化状態の制御が困難である。また、記録画像にカブリが生ずるとか、記録ヘッドのマルチノズル化が困難で高速記録には不向きであるといった欠点がある。

【０００８】一方、第４の方式は、比較的多くの利点を持つ。まず、構成がシンプルである。また、オンデマンドで記録液体をノズルの吐出口より吐出させて記録を行うために、第１～第３の方式のように吐出飛翔する小滴の内、画像記録に要しなかった小滴を回収する必要がない。また、第１，２の方式のように、導電性の記録液体を使用する必要はなく、記録液体の物質上の自由度が大きいといった利点を持つ。しかし、反面、記録ヘッドの加工上に問題があり、所望の共振周波数を有するピエゾ振動素子の小型化が極めて困難である等の理由から、記録ヘッドのマルチノズル化が難しい。また、ピエゾ振動素子の機械的振動という機械的エネルギーによって記録液体の小滴の吐出飛翔を行わせるので、上記のマルチノズル化の困難さと相俟って、高速記録には不向きのものとなっている。

【０００９】そこで、従来より提案された特公昭５６－９４２９号公報に開示のインクジェット記録方式によれば、このような不都合もほぼ解消し得る。これは、液室内のインクを加熱して気泡を発生させて、インクに圧力上昇を生じさせ、微細な毛細管ノズルからインクを飛び出させて記録させるものである。

【００１０】同様な記録方式として、特公昭６１－５９９１４号公報に開示されたものもある。これは、液体を所定の方向に吐出させるための吐出口に連通する液路中の液体の一部を熱して膜沸騰を生起させることにより、

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吐出口より吐出される液体の飛翔的液滴を形成し、この液滴を被記録体に付着させて記録させるものである。

【００１１】この方式の記録ヘッドの、より具体的な製造方法は、特公昭６２－５９６７２号公報に記載されているように、基板上の所定位置にインクに液滴発生のためのエネルギーを与えるエネルギー源として発熱素子、圧電素子等の能動素子を複数個固定的に設置した後（電極は適宜形成される）、基板表面に所定厚さで感光性組成物層を塗布法等により形成し、通常のフォトリソグラフィー法により、オリフィス部、作用部、インク供給路部、インク吐出路部等のインク流路を形成するためのインク流路溝を形成し、この後上蓋を接合させて記録ヘッドを製造するようにしている。このようにフォトリソ技術を用いることにより、高密度化が可能となる。しかしながら、この記録方法では、インクの中で発熱体を高温に発熱させること、さらには気泡を瞬間的に膨張・消滅させるため、その熱ストレスや、衝撃で発熱体が劣化しやすく、また、使用できるインクに自由度が少ないという欠点がある。

【００１２】この欠点を解決し、しかもフォトリソ技術の使用による高密度化を実現した方法として、特開平３－２９３１４１号公報に記載された技術がある。これは、基板と振動板の電極間に電圧を印加し、静電力によって振動板をたわませてインク吐出を行う記録方法で、そのヘッド形成方法として、シリコン基板にエッチングによって液室と振動板を形成するものである。また、このインクジェットヘッドとプリント板との取り付け方法として、特開平７－２４６７０６号公報に記載されているような、ヘッド電極とプリント板とを異方導電性膜で接合する方法が開示されている。また、その他の接続方法としては、ハンダを用いる方法も一般的に知られている。異方導電膜もハンダも、これらをプリント基板と電極との間に介して接続する方法であり、その加工方法は熱圧着が一般的に用いられる。

【００１３】

【発明が解決しようとする課題】しかしながら、接合後に異方導電膜やハンダがノズル板や、振動板に接触したり、ノズルのクリーニング時などにノズル面から回り込んだインクが、異方導電性膜やハンダに接触して隣接電極がリークしたりするという不具合が生じる可能性があるが、これらに関しては、何ら開示されていない。

【００１４】本発明はこれらの問題点に鑑みてなされたものであり、高密度のノズル配列を実現したインクジェット記録装置で個別電極とプリント基板の接続方法の信頼性を向上できると共に低コスト化を図ることができるインクジェット記録装置の記録ヘッド製造方法を提供することを目的とする。

【００１５】

【課題を解決するための手段】前記問題点を解決するために、振動板の変位によりノズルからインク液滴を吐出

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する液室ユニットと、電圧印加手段によって個別電極と共通電極の間に電圧を印加して振動板を変位させるアクチュエータユニットとを有する、本発明に係るインクジェット記録装置の記録装置の記録ヘッド製造方法によれば、個別電極と電圧印加手段を接続するためのプリンタ基板上の配線パターンは、アクチュエータユニットの間に絶縁間隔を置いて個別電極と導電性材料で電気的に接続される。また、複数の個別電極が形成された電極基板と、各個別電極に対応して接続される複数の振動板が形成されると共に共通電極として機能する振動板基板と、該振動板基板に対向して設けられると共にノズルに連通するインク流路を形成する液室基板と、個別電極と振動板の間に電圧を印加して振動板を変位させる電圧印加手段とを有し、電圧印加手段によって個別電極と振動板間に電圧を印加して振動板を変位させてノズルからインク液滴を吐出する、本発明に係るインクジェット記録装置の記録ヘッド製造方法によれば、個別電極と電圧印加手段を接続するためのプリンタ基板上の配線パターンは、振動板基板の端部の間に絶縁間隔を置いて個別電極と導電性材料で電気的に接続される。更に、絶縁間隔は導電性材料の膜厚以上であり、またその導電性材料の膜厚が１００μｍ以下である。また、絶縁間隔を絶縁材料により形成する。よって、ハンダや異方導性電膜等の導電性材料がプリント基板上の配線パターンからはみ出しても、アクチュエータユニット、特に振動板基板と接触することがなく、安定した、信頼性のある電力供給ができる。また、アクチュエータユニットを構成する液室基板として、ＳＵＳなどの比較的安価な材料を用いることが可能となり、記録ヘッド全体の価格を下げることができる。

【００１６】

【発明の実施の形態】個別電極と電圧印加手段を接続するためのプリント基板上の配線パターンは、振動板基板の端部の間に絶縁間隔を置いて個別電極と導電性材料で電気的に接続される。

【００１７】

【実施例】図１は本発明の第１の実施例に係るインクジェット記録装置の記録ヘッドの構成を示す図である。同図の（ａ）は斜視図、同図の（ｂ）は同図の（ａ）中の矢印Ａ方向からみた側面図、同図の（ｃ）は同図の（ａ）におけるＢ－Ｂ’断面図である。同図において、本実施例におけるインクジェット記録装置の記録ヘッド１は、液室基板１１、振動板基板１２、電極基板１３、プリント基板であるＦＰＣ（Flexible Printed Circuit：フレキシブル・プリント・サーキット）１４、ノズル１５、ＦＰＣ１４のベース１６、ＦＰＣ１４の電極リード１７、個別電極１８、振動板１９、液室２０、ＦＰＣ１４の電極リード１７と電極基板１３の個別電極１８を電気的に接続する、例えばハンダや異方導電性膜等の導電性材料２１を含んで構成されている。また、共通液

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室２２は各液室に連通し、インクを供給する液室であり、ギャップ２３は個別電極１８と振動板１９との間のギャップである。なお、説明を簡略するために、インク液室へのインク供給手段などは省略しており、図１の（ｃ）は、簡単のため、１チャンネルのみ示している。

【００１８】また、振動板基板１２はＳＵＳなどの金属やＳｉをエッチングすることで、所望の厚さで、微細なパターンを精度良く形成することができ、振動板基板１２そのものを共通電極としても使用できるため好ましい。更に、ガラスなどの絶縁性の材料を用いた場合には、表面にＡｌ、Ｃｕ、Ｃｒ、Ｎｉ、Ａｕなどの金属を蒸着やスパッタなどの方法で成膜しておくことで、共通電極が形成できる。

【００１９】そして、電極基板１３は、ＳＵＳなどの金属や、ガラス、Ｓｉ等をエッチングすることにより、所望の高さのギャップを形成し、更にそのギャップにＮｉ、Ａｌ、Ｔｉ／Ｐｔ、Ｃｕなどの電極材料を、スパッタ、ＣＶＤ、蒸着などの成膜技術で所望の厚さに成膜し、その後フォトレジストを形成してエッチングすることにより、ギャップ２３にのみに個別電極１８を形成することができる。電極基板１３として、金属を用いた場合には、その上に樹脂やSiO_2などの絶縁性の材料で絶縁層を形成し、その上に個別電極１８が形成される。個別電極１８の上には、さらに短絡、放電により電極が破損するのを防止する目的で、SiO_2などによる絶縁層を形成してもよい。

【００２０】また、ノズル１５は、液室基板１１に、ダイシングなどの機械加工や、エッチング等のエレクトロフォーミングなどの周知の方法で溝が形成され、液室基板１１と振動板基板１２を接合することで流路が形成され、その端面をノズルとして形成できる。液室基板１１の材料としては、ＳＵＳなどの金属やＳｉなどの半導体、ガラスなどの絶縁性材料などが用いられる。導電性の材料、例えば金属やＳｉを用いた場合には、内部のインクをグランドレベルに落とすために、液室基板１１をグランドに接続するのが好ましい。ノズル面の吐出表面には、インクとの撥水性を確保するため、周知の方法、例えばメッキ、あるいは撥水剤コーティングなどで撥水処理が行われている。なお、液室基板１１、振動板基板１２、電極基板１３は、接着剤や陽極接合などの直接接合方法等により接合される。

【００２１】一方、ＦＰＣ１４としては、ガラスエポキシ樹脂やフェノール樹脂等からなる板状のプリント基板や、ポリイミド樹脂、ＰＥＴ樹脂等からなるフィルム状のプリント基板が用いられる。ＦＰＣ１４のベース１６上には、個別電極１８に電圧を印加するための電極リード１７が形成されている。

【００２２】更に、ＦＰＣ１４上の電極リード１７と個別電極１８の電極パッドを電気的に接続する方法としては、例えば、ハンダを熱圧着する方法、異方導電性接着

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剤で熱圧着する方法、電極間同士を圧接する方法がある。これらは、複数の電極間同士の接続を一度に行えることから、加工が容易で、低コストであるという点で優れた方法である。さらに、この中でも、ハンダや異方導電性膜の熱圧着は、圧着後に基板同士が接着されるため、その後の加工、組み立てや、印字動作などで接続部が取れる心配がなく、信頼性という点で特に優れた接続方法である。ＦＰＣ１４と接続するに当たっては、電極基板１３の上に振動板基板１２を設けた構成では、電極取り出しのために、電極基板１３を振動板基板１２より大きしておき、電極パッド部を表面に出した構成とする必要がある。この状態で、ＦＰＣ１４をハンダや異方導電性膜で接続すると、図２中の参照符号Ｃで示すように、ＦＰＣ１４の端部で間に介したハンダや異方導電性膜が熱圧着時の圧力によってはみ出してしまう。本実施例のインクジェット装置の記録ヘッド１では、振動板基板１２が共通電極となっている。Ｓｉを用いたときなどは、振動板基板１２そのものが共通電極となり、ＦＰＣ１４側は振動板基板１２が露出してしまう。また、ガラスなどの表面に金属材料で共通電極を形成したときにも、加工の容易さから、振動板基板１２の全面に共通電極を形成するのが良く、その場合でも端部において、共通電極が露出してしまう。そのため、ＦＰＣ１４の電極、個別電極１８と、共通電極が短絡してしまうという不具合が生じる。

【００２３】そこで、本実施例では、ＦＰＣ１４の電極リード１７の端部と振動板基板１２との間に、絶縁間隔を確保するための隙間を設け、かつその隙間は異方導電性膜やハンダがはみ出しても振動板基板１２と接触しない離間距離に設定するものとする。ここで、異方導電性膜を用いる例を示す。異方導性電膜（又は異方導電フィルム）である導電性材料１１は、熱可塑性、あるいは熱硬化性の樹脂の中に、フィラーと呼ばれる導電性の粒子を分散させたもので、電極の間に挟んで加熱、加圧することで、異方導性電膜である導電性材料１１がつぶれて、フィラーが両電極に接触して、電極間の導通が取れるものである。更に、液室基板１１あるいは振動板基板１２の露出部は絶縁性の材料で被覆されている。この絶縁性の材料としては、比較的に容易に絶縁できる点で、液状の樹脂が好ましく用いられる。そのほか、Ｓｉで液室基板１１や振動板基板１２を作成した場合には、高温で加熱することにより、SiO_2 の層を表面に形成してもよい。これにより、半田や異方性導電膜のはみ出しが生じても、ＦＰＣ１４の電極パターンと液室基板１１や振動板基板１２とが接触することがなく、リークの発生が生じない。

【００２４】また、図３の（ａ）に示すように、ＦＰＣ１４などのプリント基板の電極部に、ＦＰＣ１４の端面に位置するように位置合わせを行った後に、仮圧着して、ＦＰＣ１４と異方導電性膜である導電性材料１１を

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密着させる。よって、異方導電性膜である導電性材料１１をＦＰＣ１４の端面で位置合わせを行なうので、異方導電性膜である導電性材料１１の圧着位置を決めるための特別なパターンや部材、形状を必要とせずに、異方導電性膜である導電性材料１１の位置にバラツキが生じにくく、従ってＦＰＣ１４と個別電極１８の接続面積にばらつきが無い。そのため、接触抵抗のバラツキが少なくなるため、ヘッド間で振動板１９と個別電極１８の間にかかる電圧（振動板の駆動電圧）のバラツキが少なく、どのヘッドにおいても、安定した吐出性能が得られる。また、ＦＰＣ１４の電極配列方向に曲がって圧着されることもないため、ヘッド内でも全てのノズルでほぼ等しい駆動電圧がかかり、ノズル間のバラツキも少なくなる。その後、図３の（ｂ）に示すように、異方導電性膜である導電性材料１１の保護フィルムを除去し、電極基板１３の電極パッド部と、ＦＰＣ１４の電極リード１７とを位置合わせを行う。その後、図３の（ｃ）に示すように、加熱した圧着ヘッド２４を電極領域に押し当てて、熱圧着する。この時、異方導電性膜である導電性材料１１はつぶされ、ＦＰＣ１４の端部方向に広がるが、予め広がる量を見越して、ＦＰＣ１４の先端を振動板基板１２と放して位置合わせしているので、圧着後にＦＰＣ１４の端部からはみ出しても、振動板基板１２と接触することはない。

【００２５】更に、ＦＰＣ１４の先端と振動板基板１２の先端との間の隙間の間隔は、異方導電性膜である導電性材料１１の膜厚にもよるが、圧着実験では、好ましくはＦＰＣ１４の端部から膜厚以上であれば、加熱、圧着しても、振動板基板１２に接触することがなかった。更に、異方導電性膜である導電性材料１１の膜厚が厚すぎると、ＦＰＣ１４の先端と振動板基板１２との間隔が広くなりすぎ、そのために電極基板１３が大きくなってしまい、電極基板１３のコストが高くなるという不具合が生じる。しかしながら、異方導電性膜である導電性材料１１の厚さを１００μｍ以下とすることで、電極基板１３の厚さをそれほど大きくする必要がなく、コストのアップもほとんどなくなる。

【００２６】なお、本実施例はインクの噴射方向が振動板面と垂直方向である、いわゆるサイドシュータ型のインクジェットの場合を述べたが、サイドシュータ型のヘッドでも同様の問題があって本実施例は効果的である。

【００２７】以下に、本実施例による具体例を示すこととする。図１の構成で、記録ヘッド１を作成した。インクの液室２０の幅は０．１３ｍｍ、奥行き２．０ｍｍ、ピッチを０．１６９ｍｍ（３００ｄｐｉ）とした。Ｓｉのエッチングで厚さ５μｍの振動板１９を形成した板厚０．５ｍｍの振動板基板１２と、０．５μｍの溝（ギャップとなる）の底部に、ＴｉＮの個別電極（幅０．１４ｍｍ、ピッチ０．１６９ｍｍ）を形成し、さらにその上に１００ｎｍのSiO_2 の絶縁層を形成した電極基板１

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３を接着剤で接合し、さらに振動板基板１２の上に、板厚０．５μｍの液室基板１１を接続して記録ヘッド１を形成した。この時ノズル１５の高さは２０μｍとした。ノズル数は１９２チャンネルである。ＦＰＣ１４には、前述のように、端部に位置合わせをして、異方導電性膜（スリーボンド製３３７０Ｃ、膜厚３５μｍ）が仮圧着されている。仮圧着は、圧着機の圧着ヘッドの温度を１５０℃、圧着圧力を２．９４×10^6 Ｐａ、圧着時間を１秒で行った。さらに、このＦＰＣ１４の電極リード１７を、ヘッドの電極パッドに間隔（０、１０μｍ、２０μｍ、３５μｍ、５０μｍ、１００μｍ）開けて、位置合わせをした状態で、本圧着した。本圧着は、圧着ヘッドの温度を１５０℃、加圧力を２．９４×10^6 Ｐａ、圧着時間を２０秒で行った。これにより、異方導電性フィルムにより、個別電極１８とＦＰＣ１４の電極が接着され、ＦＰＣ１４、異方導電性フィルムを介して、個別電極１８に駆動電圧が供給できるようにした。また、この記録ヘッド１のインクの液室２０に連通したインク供給口を通して、インクタンクからインクが供給できるようにした。

【００２８】このインク飛翔の記録ヘッドユニットは、インク供給管（インク供給手段）に接続された中空のインク供給室を有して形成されたマニホールドをベース材として構成されている。マニホールドの頂部には、記録ヘッドチップが固定され、インク供給管から供給されたインクは、インク供給室を通って、マニホールドの頂部に導かれ、記録ヘッドチップの端に設けられたインク供給口から記録ヘッドチップの共通流路に供給され、その後は、各インク供給チャンネルの毛管現象により、各エネルギー作用部まで運ばれる。更に、記録ヘッドチップは周囲を覆い、枠状の保持部材により押え固定される。

【００２９】次に、本実施例による具体例の動作を説明する。先ず、インク供給管よりインク供給口に供給されたインクは、共通流路をとおって、インク供給チャンネル全域に満たされている。画像情報に応じて各個別電極に対して個別に通電を行うと、個別電極１８と振動板１９との間で静電気力が発生し、振動板１９が個別電極１８側に変位する。次に、通電をＯＦＦすると、振動板１９は元の状態に戻ろうとする。この時の急激な容積変化により、インクがノズルより液滴となって飛翔する。

【００３０】このヘッドの振動板基板１２をグランドにして、個別電極１８に下記のようなパルス電圧を印加し、その駆動波形をオシロスコープで観察したところ、間隔が０、１０μｍ、２０μｍのときには、グランドとリークした波形（グランドレベルの波形）となったが、膜圧が３５μｍ以上のときには、グランドとのリーク、隣接電極とのリークの発生は見られなかった。

【００３１】

駆動電圧　：４０Ｖ
パルス幅　：１５μｓｅｃ

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連続駆動周波数　：１０ｋＨｚ

【００３２】図４は本発明の第２の実施例における問題点を説明する図である。同図において、図２と同じ参照符号は同じ構成要素を示す。本実施例によれば、ＦＰＣ１４をハンダや異方導電性膜で接続すると、ＦＰＣ１４の電極リード１７の間に介したハンダや異方導電性膜が熱圧着時の圧力によってはみ出してしまう。その時、ＦＰＣ１４側は液室基板１１が露出してしているため、振動板基板１２だけでなく、液室基板１１と接触してしまう可能性がある。液室基板１１を導電性の材料で作成した場合には、前述したように液室基板１１がグランドに接続されるため、またガラスなどの表面に金属材料で共通電極を形成したときにも、加工の容易さから、振動板基板１２の全面に共通電極を形成するのが良く、その場合でも端部において、共通電極が露出してしまう。そのため、ＦＰＣ１４の電極、個別電極１８と、グランドレベルの液室基板１１が短絡してしまうという不具合が生じる。

【００３３】本実施例では、液室基板１１とＦＰＣ１４の電極リード１７の端部との間に、絶縁間隔を確保するための隙間を設け、かつその隙間は異方導電性膜やハンダがはみ出しても液室基板１１と接触しない離間距離に設定するものとする。異方導電性膜を用いる例を示す。異方導電性膜（又は異方導電フィルム）は、熱可塑性、あるいは熱硬化性の樹脂の中に、フィラーと呼ばれる導電性の粒子を分散させたもので、電極の間に挟んで加熱、加圧することで、異方導電性膜がつぶれて、フィラーが両電極に接触して、電極間の導通が取れるものである。図３の（ａ）に示すように、ＦＰＣ１４などのプリント基板の電極部に、ＦＰＣ１４の端面に位置するように位置合わせを行った後に、仮圧着して、ＦＰＣ１４と異方導電性膜を密着させる。よって、異方導電性膜をＦＰＣ１４の端面で位置合わせを行なうので、異方導電性膜の圧着位置を決めるための特別なパターンや部材、形状を必要とせずに、異方導電性膜の位置にバラツキが生じにくく、従ってＦＰＣ１４と個別電極１８の接続面積にばらつきが無い。そのため、接触抵抗のバラツキが少なくなるため、ヘッド間で振動板１９と個別電極１８の間にかかる電圧（振動板の駆動電圧）のバラツキが少なく、どのヘッドにおいても、安定した吐出性能が得られる。また、ＦＰＣ１４の電極配列方向に曲がって圧着されることもないため、ヘッド内でも全てのノズルでほぼ等しい駆動電圧がかかり、ノズル間のバラツキも少なくなる。その後、図３の（ｂ）に示すように、異方導電性膜の保護フィルムを除去し、電極基板１３の電極パッド部と、ＦＰＣ１４の電極リード１７とを位置合わせを行う。その後、図３の（ｃ）に示すように、加熱した圧着ヘッド２４を電極領域に押し当てて、熱圧着する。この時、異方導電性膜はつぶされ、ＦＰＣ１４の端部方向に広がるが、予め広がる量を見越して、ＦＰＣ１４の先端

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を液室基板１１の端面と放して位置合わせしているので、圧着後にＦＰＣ１４の端部からはみ出しても、液室基板１１と接触することはない。また、ＦＰＣ１４の先端と液室基板１１の先端との間の隙間の間隔は、異方導電性膜の膜厚にもよるが、圧着実験では、好ましくはＦＰＣ１４の端部から膜厚以上であれば、加熱、圧着しても、振動板１９に接触することがなかった。別の言い方をすれば、異方導電性膜の膜厚は一般的には、２５～５０μｍ程度であるため、２５μｍ以上、好ましくは５０μｍ以上設けるのがよい。

【００３４】図５は本発明に係るインクジェット記録装置におけるＦＰＣ上の電極リードのパターンの一例を示す図である。同図からわかるように、パターン面は半田メッキされており、個別電極と接触した状態で加熱された圧着ヘッドで押圧されることで、半田が溶融し、圧着ヘッドをはずすことで、溶融した半田が固化し、ＦＰＣ上の電極リードのパターンと、個別電極が接続される。このときＦＰＣ上の電極リードのパターンが、ＦＰＣのベース端面より内側に形成されて、相対的に絶縁間隔を設けているため、半田が押圧されて、ＦＰＣの端面側にはみ出しても、プリント基板の端面から先にはみ出すことがなく、よって振動板基板や液室基板と接触することがない。

【００３５】なお、本発明は上記実施例に限定されるものではなく、特許請求の範囲内の記載であれば多種の変形や置換可能であることは言うまでもない。

【００３６】

【発明の効果】以上説明したように、振動板の変位によりノズルからインク液滴を吐出する液室ユニットと、電圧印加手段によって個別電極と共通電極の間に電圧を印加して振動板を変位させるアクチュエータユニットとを有する、本発明に係るインクジェット記録装置の記録装置の記録ヘッド製造方法によれば、個別電極と電圧印加手段を接続するためのプリンタ基板上の配線パターンは、アクチュエータユニットの間に絶縁間隔を置いて個別電極と導電性材料で電気的に接続される。また、複数の個別電極が形成された電極基板と、各個別電極に対応して接続される複数の振動板が形成されると共に共通電

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極として機能する振動板基板と、該振動板基板に対向して設けられると共にノズルに連通するインク流路を形成する液室基板と、個別電極と振動板の間に電圧を印加して振動板を変位させる電圧印加手段とを有し、電圧印加手段によって個別電極と振動板間に電圧を印加して振動板を変位させてノズルからインク液滴を吐出する、本発明に係るインクジェット記録装置の記録ヘッド製造方法によれば、個別電極と電圧印加手段を接続するためのプリンタ基板上の配線パターンは、振動板基板の端部の間に絶縁間隔を置いて個別電極と導電性材料で電気的に接続される。更に、絶縁間隔は導電性材料の膜厚以上であり、またその導電性材料の膜厚が１００μｍ以下である。また、絶縁間隔を絶縁材料により形成する。よって、ハンダや異方導性電膜等の導電性材料がプリント基板上の配線パターンからはみ出しても、アクチュエータユニット、特に振動板基板と接触することがなく、安定した、信頼性のある電力供給ができる。また、アクチュエータユニットを構成する液室基板として、ＳＵＳなどの比較的安価な材料を用いることが可能となり、記録ヘッド全体の価格を下げることができる。

【図面の簡単な説明】

【図１】本発明の第１の実施例に係るインクジェット記録装置の記録ヘッドの構成を示す図である。

【図２】第１の実施例における問題点を説明する図である。

【図３】第１の実施例におけるプリント基板と導電性材料の圧着の様子を示す図である。

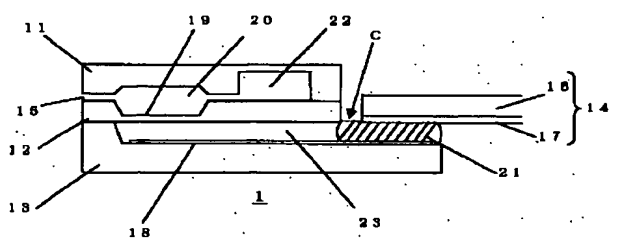
【図４】本発明の第２の実施例における問題点を説明する図である。

【図５】本発明に係るインクジェット記録装置におけるプリント基板と個別電極との接触部のパターンの一例を示す図である。

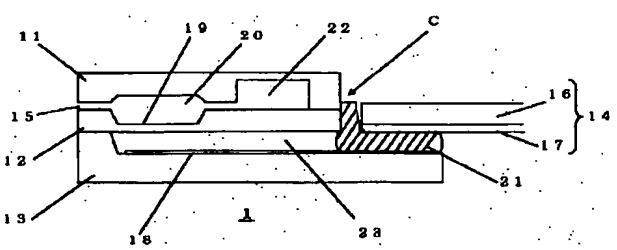
【符号の説明】

１：記録ヘッド、１１：液室基板、１２：振動板基板、１３：電極基板、１４：プリント基板、１５：ノズル、１６：ベース、１７：電極リード、１８：個別電極、１９：振動板、２０：液室、２１：導電性材料、２２：共通液室、２３：ギャップ、２４：圧着ヘッド。

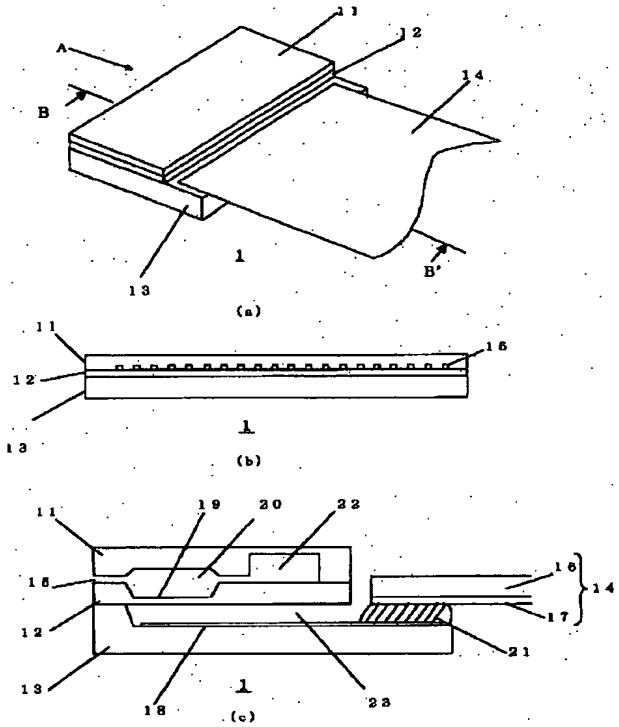
【図２】



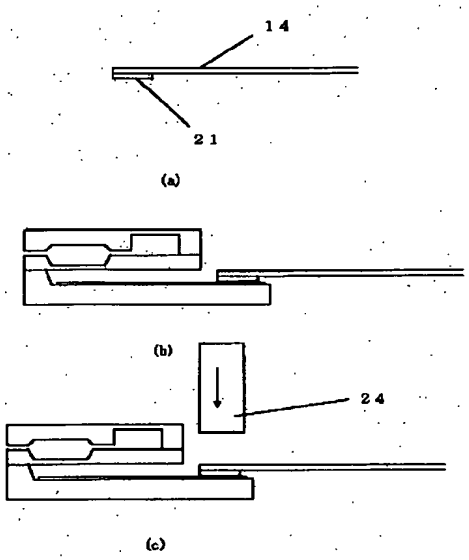
【図４】



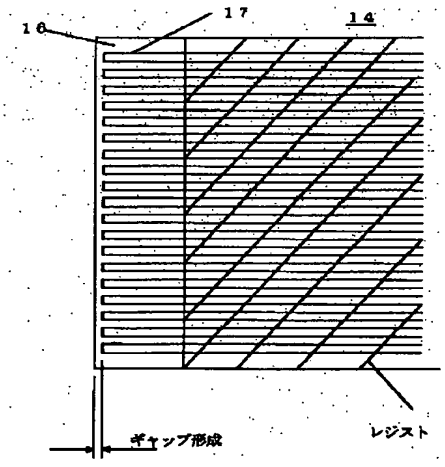
【図１】


A
B
11
12
14
13
1
B'
(a)
11
12
13
15
1
(b)
11
19
20
22
15
12
13
18
1
23
16
14
17
21
(c)

【図３】


14
21
(a)
(b)
24
(c)

【図５】


16
17
14
ポケット形成
レジスト